TERRESTRIAL AGE OF THE LAFAYETTE METEORITE AND STABLE-ISOTOPIC COMPOSITION OF WEATHERING PRODUCTS. A. J. T. Jull[1,2], C. J. Eastoe[2] and S. Cloudt[1] [1]NSF-Arizona AMS Facility, University of Arizona, Tucson, AZ 85721; e-mail: jull@U.Arizona.edu, [2]Department of Geosciences, University of Arizona.

The Lafayette SNC meteorite was first noticed in a drawer at Purdue University in 1931 by O. C. Farrington [1]. Because of their likely origin on Mars [2], SNC meteorites are of much more interest today. This meteorite is similar in petrography and mineralogy to the other nakhlites [2,3]. It has been suggested that this meteorite is part of the same fall as Nakhla [1], but Berkeley et al. [3] asserted on petrographic evidence that they are all discrete falls. We have obtained terrestrial-age information on this meteorite. Also, we have also undertaken some studies of the stable-isotopic composition of the carbonates in this meteorite, as a follow-up study to work on other Martian meteorites [4,5].

The terrestrial age of the meteorite was determined by accelerator mass spectrometry (AMS) of cosmic-ray-produced ^{14}C, as described by Jull et al [6]. The sample is first cleaned in acid to remove any weathering products. The cleaned residue is preheated to 500°C in air, and then fused at ~1700°C with ~3g of iron chips (to accelerate combustion) in an RF induction furnace, in a flow of oxygen gas. CO_2 is removed from the oxygen flow cryogenically. Oxygen is removed, and the volume of CO_2 is measured and diluted to ~1cm^3 STP with ^{14}C-free CO_2. This CO_2 is reduced to graphite powder over an Fe catalyst and this powder is pressed into an accelerator target holder for analyses by AMS [6].
Results of the ^{14}C analysis of the SNC meteorites Lafayette, Nakhla and QUE 94201 are reported in table 1, along with previously-reported results for ALH 84001, LEW 88516 and EETA 79001 and other terrestrial age information..

A measurement of the ^{14}C activity in Nakhla of about 53 dpm/kg in table 1 shows that the results are consistent with the range of average saturated activity of 61±9 dpm/kg. Saturated activity in a given sample depends on the size of the meteoroid, shielding depth and other parameters, the values in the interior of a 20-45cm radius object do not vary by more than about ±10%, but surface samples can have significantly lower activity than the interior, as shown by our ^{14}C work on Knyahinya [12]. The results on Lafayette show that it has a terrestrial age of about 9Ka, assuming that the sample came from a meteoroid of pre-atmospheric radius of ~15-50cm. Thus, this must be a separate fall from the other two Nakhlites, as suggested earlier. by Berkeley et al [3]. The difference in activity is too large to be explained by shielding effects in the same object. Of the 10 SNC meteorites so far recognized, the distribution of terrestrial ages of the SNC falls indicates only two meteorites of long terrestrial age, ALHA77005 and QUE 94201. There is one meteorite, LEW 88516 of at least 27-30Ka, and a grouping of 3 meteorites at about 9-12Ka (see table 1). The remainder are recent falls (Shergotty, Zagami, Chassigny and Nakhla). The terrestrial age of Governador Valdares has not yet been determined.

Table 1. ^{14}C contents and terrestrial ages of SNC meteorites

Sample	^{14}C (dpm/kg)	Terrestrial Age[1] (Ka)	
Nakhla	53.3±0.4	fell 1911AD	
Lafayette	20.9±0.4	8.9±1.3	
QUE 94201	<1.7	>30	
Literature ^{14}C terrestrial ages of SNC meteorites			
ALH 84001	12.2±0.8 [2]	12.7±1.3	[4,5,7]
EETA 79001	15.9±0.2	12±1 [3]	[8]
LEW 88516	2.4±0.6	27±3	[9]
Literature ^{36}Cl terrestrial ages of SNC meteorites			
ALHA77005		210±70	[10]
QUE 94201		290±50	[11]

[1].Using a saturated activity of 61 dpm/kg based on averaged oxygen content of SNC meteorites.
[2] Mean of 3 independent determinations.
[3] Using a saturated activity of 65 dpm/kg based on the oxygen content of this meteorite.

The terrestrial age, combined with compositional information and exposure history, is important for identifying whether there are discrete fall events. It is also useful in ascertaining the degree of terrestrial weathering which might be expected. However, this alone is not sufficient, so we have developed a method of looking at the ^{14}C in the fractions of gas released by acid etching. This material ought to be predominantly carbonate, Jull et al. [5, 6] note that other phases such as apatite can be soluble.

In addition to its terrestrial age, we have recovered CO_2 from bulk phosphoric-acid etching of this meteorite. These results can be compared to the results from other SNC meteorites reported by Jull et al [5,6]. We have previously suggested several possible SNC carbonate isotopic components, and the results from Lafayette plot in these same regions as discussed by Jull et al. [6]. Some initial results are shown in table 2. In figure 1, we have indicated the location of the sample points on a plot of $\delta^{13}C$ vs. $\delta^{18}O$

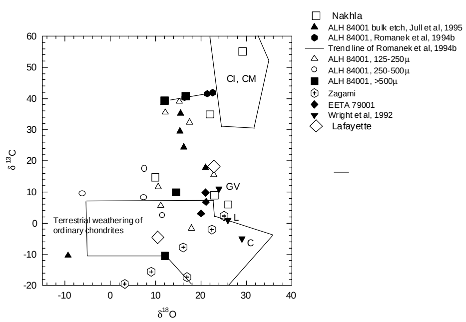
for SNC carbonates. These samples had substantial amounts of ^{14}C, suggesting exchange with terrestrial carbon dioxide. We will report further on these measurements and their significance at LPSC-28.

Table 2. Stable carbon and oxygen isotopic composition of carbonates from bulk phosphoric-acid etching of Lafayette at 25°C

Etch time, hrs	$\delta^{13}C$	$\delta^{18}O$ [1]
48	+18.20±0.01	+22.81±0.01
144	-4.62±0.06	+10.5±0.1

[1]. Assumes calcite composition

Fig. 1. Plot of $\delta^{13}C$ vs. $\delta^{18}O$ for carbon released by acid etching of SNC meteorites. The new results for Lafayette are indicated by the open diamonds. Earlier results plotted are from Jull et al. [4,5]



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